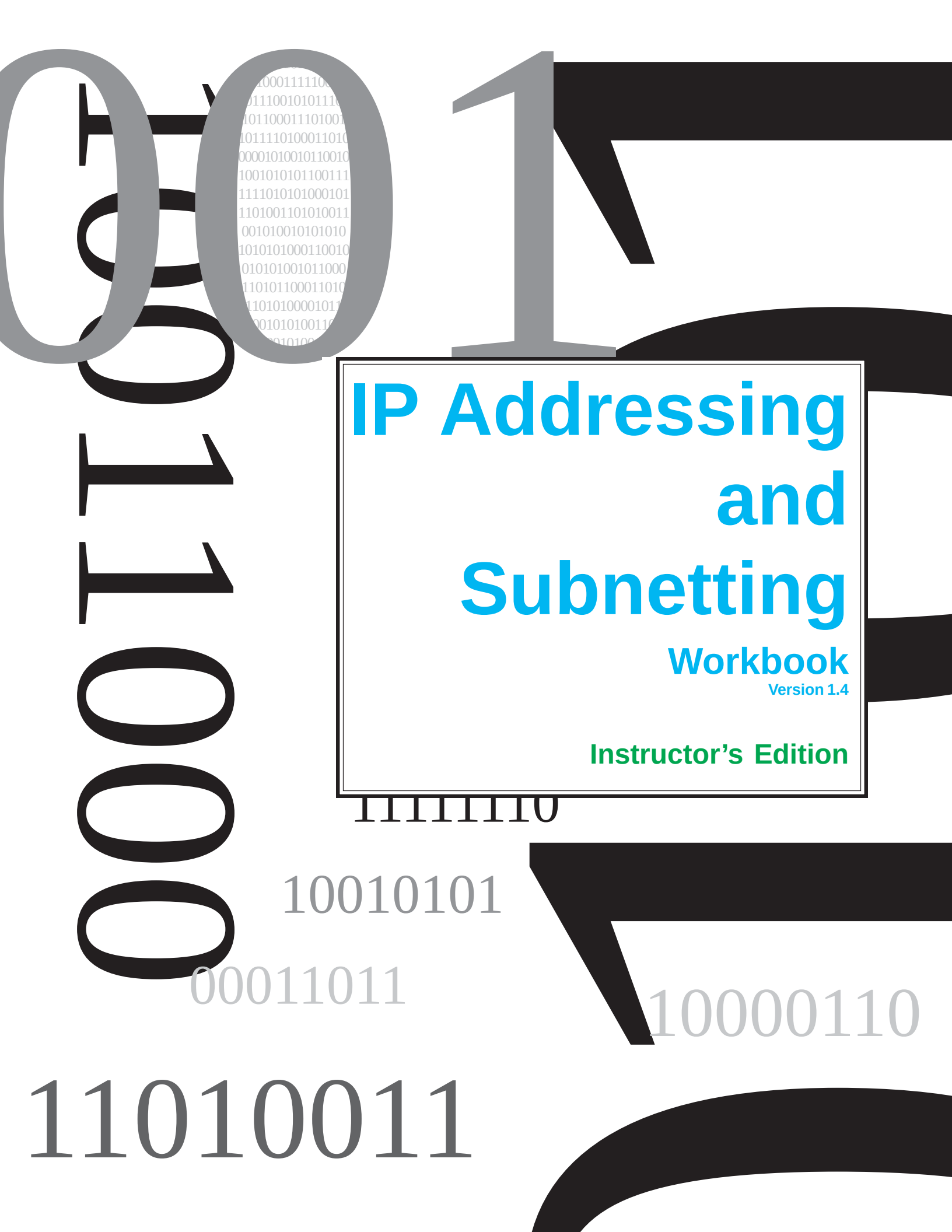

IP Addressing and Subnetting
Workbook
Version 1.4
Instructor's Edition

IP Address Classes

Class A	1 – 127	(Network 127 is reserved for loopback and internal testing) Leading bit pattern	0	00000000.00000000.00000000.00000000 Network . Host . Host . Host
Class B	128 – 191	Leading bit pattern	10	10000000.00000000.00000000.00000000 Network . Network . Host . Host
Class C	192 – 223	Leading bit pattern	110	11000000.00000000.00000000.00000000 Network . Network . Network . Host
Class D	224 – 239	(Reserved for multicast)		
Class E	240 – 255	(Reserved for experimental, used for research)		

Private Address Space

Class A	10.0.0.0 to 10.255.255.255
Class B	172.16.0.0 to 172.31.255.255
Class C	192.168.0.0 to 192.168.255.255

Default Subnet Masks

Class A	255.0.0.0
Class B	255.255.0.0
Class C	255.255.255.0

Produced by: Robb Jones
jonesr@careertech.net
Frederick County Career & Technology Center
Cisco Networking Academy
Frederick County Public Schools
Frederick, Maryland, USA

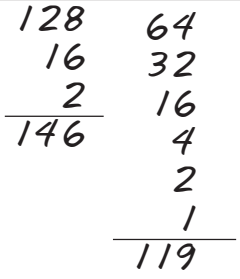
Special Thanks to Melvin Baker and Jim Dorsch
for taking the time to check this workbook for errors,
and to everyone who has sent in suggestions to improve the series.

Workbooks included in the series:
IP Addressing and Subnetting Workbook Instructors Edition
IP Addressing and Subnetting IP Workbook
Access Lists Instructors Edition
Access Lists
VLSM Variable-Length Subnet Mask Instructors Edition
VLSM Variable-Length Subnet Mask

Binary To Decimal Conversion

128	64	32	16	8	4	2	1	Answers
1	0	0	1	0	0	1	0	146
0	1	1	1	0	1	1	1	119
1	1	1	1	1	1	1	1	255
1	1	0	0	0	1	0	1	197
1	1	1	1	0	1	1	0	246
0	0	0	1	0	0	1	1	19
1	0	0	0	0	0	0	1	129
0	0	1	1	0	0	0	1	49
0	1	1	1	1	0	0	0	120
1	1	1	1	0	0	0	0	240
0	0	1	1	1	0	1	1	59
0	0	0	0	0	1	1	1	7
						00011011		27
						10101010		170
						01101111		111
						11111000		248
						00100000		32
						01010101		85
						00111110		62
						00000011		3
						11101101		237
						11000000		192

Scratch Area



Decimal To Binary Conversion

Use all 8 bits for each problem

128	64	32	16	8	4	2	1	= 255
1	1	1	0	1	1	1	0	238
0	0	1	0	0	0	1	0	34
0	1	1	1	1	0	1	1	123
0	0	1	1	0	0	1	0	50
1	1	1	1	1	1	1	1	255
1	1	0	0	1	0	0	0	200
0	0	0	0	1	0	1	0	10
1	0	0	0	1	0	1	0	138
0	0	0	0	0	0	0	1	1
0	0	0	0	1	1	0	1	13
1	1	1	1	1	0	1	0	250
0	1	1	0	1	0	1	1	107
1	1	1	0	0	0	0	0	224
0	1	1	1	0	0	1	0	114
1	1	0	0	0	0	0	0	192
1	0	1	0	1	1	0	0	172
0	1	1	0	0	1	0	0	100
0	1	1	1	0	1	1	1	119
0	0	1	1	1	0	0	1	57
0	1	1	0	0	0	1	0	98
1	0	1	1	0	0	1	1	179
0	0	0	0	0	0	1	0	2

Scratch Area

```
238
-128
 110
 -64
  46
 -32
  14
  -8
   6
  -4
   2
  -2
   0
```

```
34
-32
 2
-2
 0
```

Address Class Identification

Address	Class
10.250.1.1	A
150.10.15.0	B
192.14.2.0	C
148.17.9.1	B
193.42.1.1	C
126.8.156.0	A
220.200.23.1	C
230.230.45.58	D
177.100.18.4	B
119.18.45.0	A
249.240.80.78	E
199.155.77.56	C
117.89.56.45	A
215.45.45.0	C
199.200.15.0	C
95.0.21.90	A
33.0.0.0	A
158.98.80.0	B
219.21.56.0	C

Network & Host Identification

Circle the network portion of these addresses:

177.100.18.4

119.18.45.0

209.240.80.78

199.155.77.56

117.89.56.45

215.45.45.0

192.200.15.0

95.0.21.90

33.0.0.0

158.98.80.0

217.21.56.0

10.250.1.1

150.10.15.0

192.14.2.0

148.17.9.1

193.42.1.1

126.8.156.0

220.200.23.1

Circle the host portion of these addresses:

10.15.123.50

171.2.199.31

198.125.87.177

223.250.200.222

17.45.222.45

126.201.54.231

191.41.35.112

155.25.169.227

192.15.155.2

123.102.45.254

148.17.9.155

100.25.1.1

195.0.21.98

25.250.135.46

171.102.77.77

55.250.5.5

218.155.230.14

10.250.1.1

Network Addresses

Using the IP address and subnet mask shown write out the network address:

188.10.18.2 255.255.0.0	188 . 10 . 0 . 0
10.10.48.80 255.255.255.0	10 . 10 . 48 . 0
192.149.24.191 255.255.255.0	192 . 149 . 24 . 0
150.203.23.19 255.255.0.0	150 . 203 . 0 . 0
10.10.10.10 255.0.0.0	10 . 0 . 0 . 0
186.13.23.110 255.255.255.0	186 . 13 . 23 . 0
223.69.230.250 255.255.0.0	223 . 69 . 0 . 0
200.120.135.15 255.255.255.0	200 . 120 . 135 . 0
27.125.200.151 255.0.0.0	27 . 0 . 0 . 0
199.20.150.35 255.255.255.0	199 . 20 . 150 . 0
191.55.165.135 255.255.255.0	191 . 55 . 165 . 0
28.212.250.254 255.255.0.0	28 . 212 . 0 . 0

Host Addresses

Using the IP address and subnet mask shown write out the host address:

188.10.18.2
255.255.0.0 — 0.0.18.2

10.10.48.80
255.255.255.0 — 0.0.0.80

222.49.49.11
255.255.255.0 — 0.0.0.11

128.23.230.19
255.255.0.0 — 0.0.230.19

10.10.10.10
255.0.0.0 — 0.10.10.10

200.113.123.11
255.255.255.0 — 0.0.0.11

223.169.23.20
255.255.0.0 — 0.0.23.20

203.20.35.215
255.255.255.0 — 0.0.0.215

117.15.2.51
255.0.0.0 — 0.15.2.51

199.120.15.135
255.255.255.0 — 0.0.0.135

191.55.165.135
255.255.255.0 — 0.0.0.135

48.21.25.54
255.255.0.0 — 0.0.25.54

Default Subnet Masks

Write the correct default subnet mask for each of the following addresses:

177.100.18.4	255 . 255 . 0 . 0
119.18.45.0	255 . 0 . 0 . 0
191.249.234.191	255 . 255 . 0 . 0
223.23.223.109	255 . 255 . 255 . 0
10.10.250.1	255 . 0 . 0 . 0
126.123.23.1	255 . 0 . 0 . 0
223.69.230.250	255 . 255 . 255 . 0
192.12.35.105	255 . 255 . 255 . 0
77.251.200.51	255 . 0 . 0 . 0
189.210.50.1	255 . 255 . 0 . 0
88.45.65.35	255 . 0 . 0 . 0
128.212.250.254	255 . 255 . 0 . 0
193.100.77.83	255 . 255 . 255 . 0
125.125.250.1	255 . 0 . 0 . 0
1.1.10.50	255 . 0 . 0 . 0
220.90.130.45	255 . 255 . 255 . 0
134.125.34.9	255 . 255 . 0 . 0
95.250.91.99	255 . 0 . 0 . 0

ANDING With
Default subnet masks

Every IP address must be accompanied by a subnet mask. By now you should be able to look at an IP address and tell what class it is. Unfortunately your computer doesn't think that way. For your computer to determine the network and subnet portion of an IP address it must "AND" the IP address with the subnet mask.

Default Subnet Masks:

Class A	255.0.0.0
Class B	255.255.0.0
Class C	255.255.255.0

ANDING Equations:

1 AND 1 = 1
1 AND 0 = 0
0 AND 1 = 0
0 AND 0 = 0

Sample:

What you see...

IP Address: 192 . 100 . 10 . 33

What you can figure out in your head...

Address Class:	C
Network Portion:	**192 . 100 . 10** . 33
Host Portion:	192 . 100 . 10 . **33**

In order for you computer to get the same information it must AND the IP address with the subnet mask in binary.

	Network	Host	
IP Address:	1 1 0 0 0 0 0 0 . 0 1 1 0 0 1 0 0 . 0 0 0 0 1 0 1 0	. 0 0 1 0 0 0 0 1	(192 . 100 . 10 . 33)
Default Subnet Mask:	1 1 1 1 1 1 1 1 . 0 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1	. 0 0 0 0 0 0 0 0	(255 . 255 . 255 . 0)
AND:	1 1 0 0 0 0 0 0 . 0 1 1 0 0 1 0 0 . 0 0 0 0 1 0 1 0	. 0 0 0 0 0 0 0 0	(192 . 100 . 10 . 0)

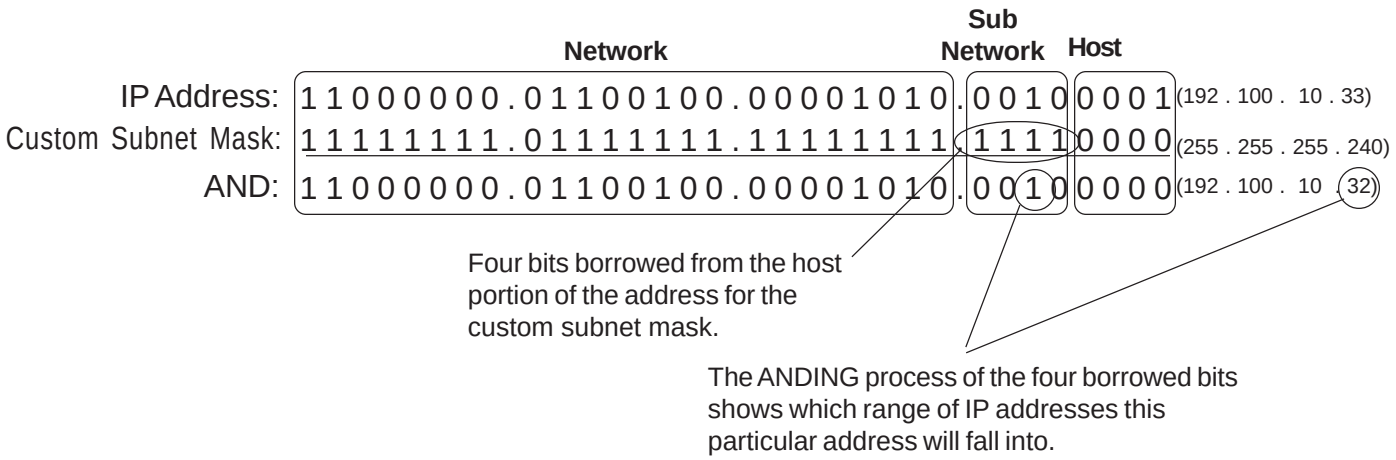
ANDING with the default subnet mask allows your computer to figure out the network portion of the address.

ANDING With
Custom subnet masks

When you take a single network such as 192.100.10.0 and divide it into five smaller networks (192.100.10.16, 192.100.10.32, 192.100.10.48, 192.100.10.64, 192.100.10.80) the outside world still sees the network as 192.100.10.0, but the internal computers and routers see five smaller subnetworks. Each independent of the other. This can only be accomplished by using a custom subnet mask. A custom subnet mask borrows bits from the host portion of the address to create a subnetwork address between the network and host portions of an IP address. In this example each range has 14 usable addresses in it. The computer must still AND the IP address against the custom subnet mask to see what the network portion is and which subnetwork it belongs to.

IP Address: 192 . 100 . 10 . 0
Custom Subnet Mask: 255.255.255.240

Address Ranges:
192.10.10.0 to 192.100.10.15 (Invalid Range)
192.100.10.16 to 192.100.10.31 (1st Usable Range)
192.100.10.32 to 192.100.10.47 (Range in the sample below)
192.100.10.48 to 192.100.10.63
192.100.10.64 to 192.100.10.79
192.100.10.80 to 192.100.10.95
192.100.10.96 to 192.100.10.111
192.100.10.112 to 192.100.10.127
192.100.10.128 to 192.100.10.143
192.100.10.144 to 192.100.10.159
192.100.10.160 to 192.100.10.175
192.100.10.176 to 192.100.10.191
192.100.10.192 to 192.100.10.207
192.100.10.208 to 192.100.10.223
192.100.10.224 to 192.100.10.239
192.100.10.240 to 192.100.10.255 (Invalid Range)



In the next set of problems you will determine the necessary information to determine the correct subnet mask for a variety of IP addresses.

Custom Subnet Masks

Problem 1

Number of needed usable subnets **14**

Number of needed usable hosts **14**

Network Address **192.10.10.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 240

Total number of subnets 16

Number of usable subnets 14

Total number of host addresses 16

Number of usable addresses 14

Number of bits borrowed 4

Show your work for Problem 1 in the space below.

	256	128	64	32	16	8	4	2	– Number of Hosts
Number of Subnets –	2	4	8	16	32	64	128	256	
	128	64	32	16	8	4	2	1	– Binary values
192 . 10 . 10 .	0	0	0	0	0	0	0	0	

Add the binary value numbers to the left of the line to create the custom subnet mask.

128
64
32
+16
240

16
−2
14

Observe the total number of hosts.

Subtract 2 for the number of usable hosts.

Subtract 2 for the total number of subnets to get the usable number of subnets.

16
−2
14

Custom Subnet Masks

Problem 2

Number of needed usable subnets **1000**

Number of needed usable hosts **60**

Network Address **165.100.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 1,024

Number of usable subnets 1,022

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 10

Show your work for Problem 2 in the space below.

										.								
Number of Hosts →	65,536	32,768	16,384	8,192	4,096	2,048	1,024	512		256	128	64	32	16	8	4	2	
Number of Subnets →	2	4	8	16	32	64	128	256	.	512	1024	2048	4,096	8,192	16,384	32,768	65,536	
Binary values →	128	64	32	16	8	4	2	1	.	128	64	32	16	8	4	2	1	
165 . 100 .	0	0	0	0	0	0	0	0	.	0	0	0	0	0	0	0	0	

Add the binary value numbers to the left of the line to create the custom subnet mask.

```
128
 64
 32
 16
  8
  4
  2
 +1
---
255
```

```
128
+64
---
192
```

```
1024
  -2
------
1,022
```

Subtract 2 for the total number of subnets to get the usable number of subnets.

```
 64
 -2
----
 62
```

Observe the total number of hosts.

Subtract 2 for the number of usable hosts.

Custom Subnet Masks

Problem 3

/26 indicates the total number of bits used for the network and subnetwork portion of the address. All bits remaining belong to the host portion of the address.

Network Address **148.75.0.0 /26**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 1,024

Number of usable subnets 1,022

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 10

Show your work for Problem 3 in the space below.

	65,536	32,768	16,384	8,192	4,096	2,048	1,024	512	.	256	128	64	32	16	8	4	2
Number of Hosts	–																
Number of Subnets	–	2	4	8	16	32	64	128	256.	512	1024	2048	4,096	8,192	16,384	32,768	65,536
Binary values	–	128	64	32	16	8	4	2	1	. 128	64	32	16	8	4	2	1
148 . 75 .		0	0	0	0	0	0	0	0	. 0	0	0	0	0	0	0	0

Add the binary value numbers to the left of the line to create the custom subnet mask.

128
64
32
16
8
4
2
+1
255

128
+64
192

64 Observe the total number of hosts.
−2 Subtract 2 for the number of usable hosts.
62

1024
−2
1,022

Subtract 2 for the total number of subnets to get the usable number of subnets.

Custom Subnet Masks

Problem 4

Number of needed usable subnets **6**

Number of needed usable hosts **30**

Network Address **210.100.56.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 224

Total number of subnets 8

Number of usable subnets 6

Total number of host addresses 32

Number of usable addresses 30

Number of bits borrowed 3

Show your work for Problem 4 in the space below.

	256	128	64	32	16	8	4	2	- Number of Hosts
Number of Subnets -	2	4	8	16	32	64	128	256	
	128	64	32	16	8	4	2	1	- Binary values
210 . 100 . 56 .	0	0	0	0	0	0	0	0	

128
64
+32
224

8
-2
6

32
-2
30

Custom Subnet Masks

Problem 5

Number of needed usable subnets **6**

Number of needed usable hosts **30**

Network Address **195.85.8.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 224

Total number of subnets 8

Number of usable subnets 6

Total number of host addresses 32

Number of usable addresses 30

Number of bits borrowed 3

Show your work for Problem 5 in the space below.

	256	128	64	32	16	8	4	2	–	Number of Hosts
Number of Subnets –	2	4	8	16	32	64	128	256		
	128	64	32	16	8	4	2	1	–	Binary values
195 . 85 . 8 .	0	0	0	0	0	0	0	0		

128 + 64 + 32 = 224

32 − 2 = 30

8 − 2 = 6

Custom Subnet Masks

Problem 6

Number of needed usable subnets **126**
Number of needed usable hosts **131,070**
Network Address **118.0.0.0**

Address class ___A___

Default subnet mask ___255 . 0 . 0 . 0___

Custom subnet mask ___255 . 254 . 0 . 0___

Total number of subnets ___128___

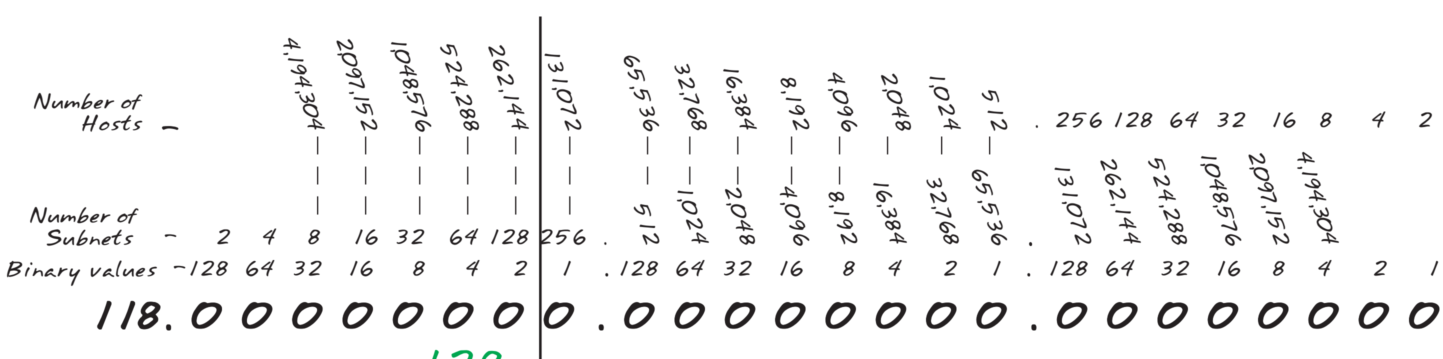
Number of usable subnets ___126___

Total number of host addresses ___131,072___

Number of usable addresses ___131,070___

Number of bits borrowed ___7___

Show your work for <u>Problem 6</u> in the space below.




```
  128
   64
   32
   16
    8          128        131,072
    4           -2             -2
   +2
  ---          ---        -------
  254          126        131,070
```

Custom Subnet Masks

Problem 7

Number of needed usable subnets **2000**

Number of needed usable hosts **15**

Network Address **178.100.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 224

Total number of subnets 2,048

Number of usable subnets 2,046

Total number of host addresses 32

Number of usable addresses 30

Number of bits borrowed 11

Show your work for Problem 7 in the space below.

Number of Hosts	–	65,536	32,768	16,384	8,192	4,096	2,048	1,024	512	.	256	128	64	32	16	8	4	2
Number of Subnets	–	2	4	8	16	32	64	128	256	.	512	1024	2048	4,096	8,192	16,384	32,768	65,536
Binary values	–	128	64	32	16	8	4	2	1	.	128	64	32	16	8	4	2	1
178 . 100 .		0	0	0	0	0	0	0	0	.	0	0	0	0	0	0	0	0

128
64
32
16
8
4
2
+1
255

2,048
-2
2,046

32
-2
30

Custom Subnet Masks

Problem 8

Number of needed usable subnets **1**

Number of needed usable hosts **45**

Network Address **200.175.14.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 4

Number of usable subnets 2

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 2

Show your work for Problem 8 in the space below.

	256	128	64	32	16	8	4	2	- Number of Hosts
Number of Subnets -	2	4	8	16	32	64	128	256	
	128	64	32	16	8	4	2	1	- Binary values
200 . 175 . 14 .	0	0	0	0	0	0	0	0	

128 + 64 = 240

4 - 2 = 2

64 - 2 = 62

Custom Subnet Masks

Problem 9

Number of needed usable subnets **60**

Number of needed usable hosts **1,000**

Network Address **128.77.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 252 . 0

Total number of subnets 64

Number of usable subnets 62

Total number of host addresses 1,024

Number of usable addresses 1,022

Number of bits borrowed 6

Show your work for Problem 9 in the space below.

									.								
Number of Hosts →	65,536	32,768	16,384	8,192	4,096	2,048	1,024	512	.	256	128	64	32	16	8	4	2
Number of Subnets →	2	4	8	16	32	64	128	256	.	512	1024	2048	4,096	8,192	16,384	32,768	65,536
Binary values →	128	64	32	16	8	4	2	1	.	128	64	32	16	8	4	2	1
128 . 77 .	0	0	0	0	0	0	0	0	.	0	0	0	0	0	0	0	0

128
64
32
16
8
+4
252

64
-2
62

1,024
-2
1,022

Custom Subnet Masks

Problem 10

Number of needed usable hosts **60**

Network Address **198.100.10.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 4

Number of usable subnets 2

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 2

Show your work for Problem 10 in the space below.

	256	128	64	32	16	8	4	2	– Number of Hosts
Number of Subnets –	2	4	8	16	32	64	128	256	
	128	64	32	16	8	4	2	1	– Binary values
198 . 100 . 10 .	0	0	0	0	0	0	0	0	

128	64	4
+64	−2	−2
192	62	2

Custom Subnet Masks

Problem 11

Number of needed usable subnets **250**

Network Address **101.0.0.0**

Address class: A

Default subnet mask: 255 . 0 . 0 . 0

Custom subnet mask: 255 . 255 . 0 . 0

Total number of subnets: 256

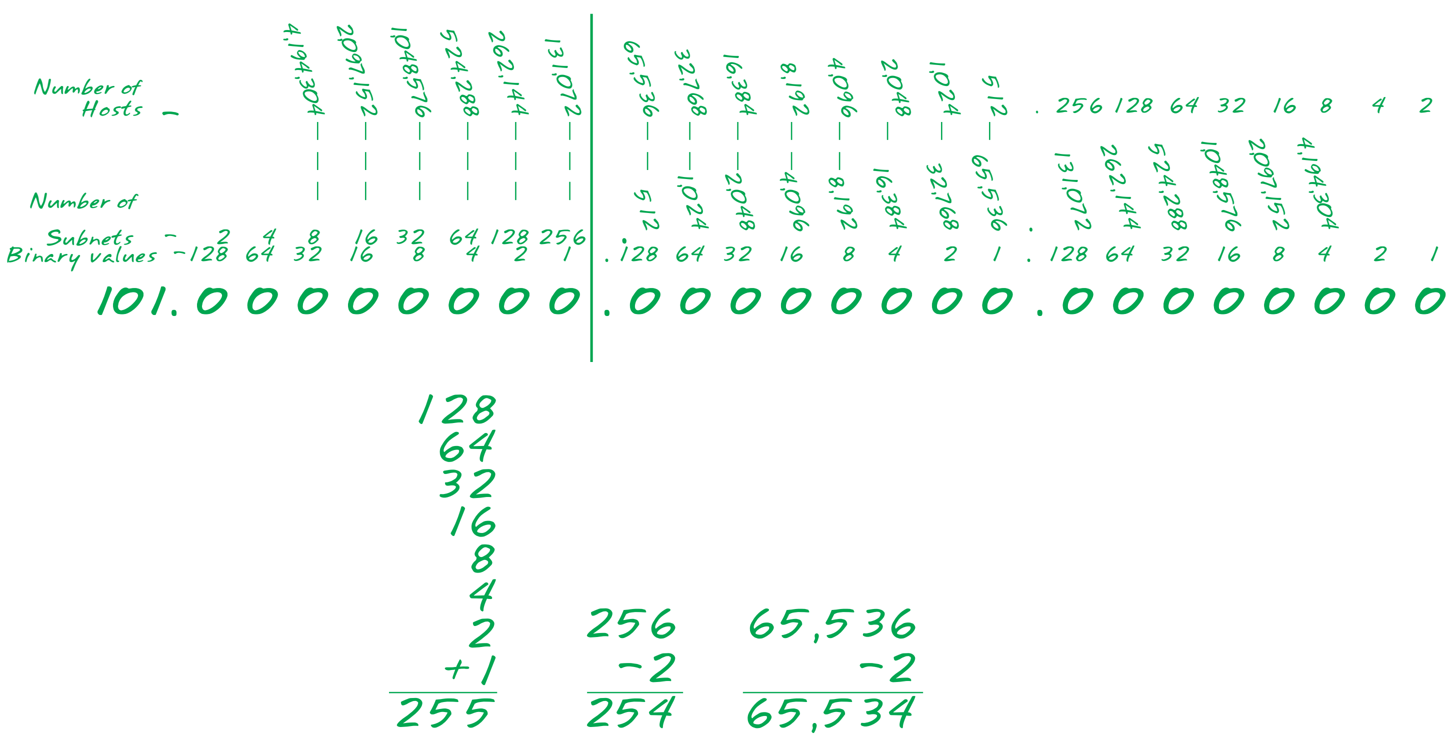
Number of usable subnets: 254

Total number of host addresses: 65,536

Number of usable addresses: 65,534

Number of bits borrowed: 8

Show your work for <u>Problem 11</u> in the space below.



Custom Subnet Masks

Problem 12

Number of needed usable subnets **5**

Network Address **218.35.50.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 224

Total number of subnets 8

Number of usable subnets 6

Total number of host addresses 32

Number of usable addresses 30

Number of bits borrowed 3

Show your work for <u>Problem 12</u> in the space below.

	256	128	64	32	16	8	4	2	- Number of Hosts
Number of Subnets -	2	4	8	16	32	64	128	256	
	128	64	32	16	8	4	2	1	- Binary values
218 . 35 . 50 .	0	0	0	0	0	0	0	0	

128
64
+32
224

64
-2
62

4
-2
2

Custom Subnet Masks

Problem 13

Number of needed usable hosts **25**

Network Address **218.35.50.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 224

Total number of subnets 8

Number of usable subnets 6

Total number of host addresses 32

Number of usable addresses 30

Number of bits borrowed 3

Show your work for Problem 13 in the space below.

	256	128	64	32	16	8	4	2	- Number of Hosts
Number of Subnets -	2	4	8	16	32	64	128	256	
	128	64	32	16	8	4	2	1	- Binary values
218 . 35 . 50 .	0	0	0	0	0	0	0	0	

128
64
+32
224

8
-2
6

32
-2
30

Custom Subnet Masks

Problem 14

Number of needed usable subnets **10**

Network Address **172.59.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 240 . 0

Total number of subnets 16

Number of usable subnets 14

Total number of host addresses 4,096

Number of usable addresses 4,094

Number of bits borrowed 4

Show your work for Problem 14 in the space below.

Number of Hosts	-	65,536	32,768	16,384	8,192	4,096	2,048	1,024	512	.	256	128	64	32	16	8	4	2	
Number of Subnets	-	2	4	8	16	32	64	128	256	.	512	1024	2048	4,096	8,192	16,384	32,768	65,536	
Binary values	-	128	64	32	16	8	4	2	1	.	128	64	32	16	8	4	2	1	
172 . 59 .		0	0	0	0	0	0	0	0	.	0	0	0	0	0	0	0	0	

128
64
32
+16
240

16
-2
14

4,096
-2
4,094

Custom Subnet Masks

Problem 15

Number of needed usable hosts **50**

Network Address **172.59.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 1,024

Number of usable subnets 1,022

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 10

Show your work for Problem 15 in the space below.

Number of Hosts →	65,536	32,768	16,384	8,192	4,096	2,048	1,024	512	.	256	128	64	32	16	8	4	2	
Number of Subnets →	2	4	8	16	32	64	128	256	.	512	1024	2048	4,096	8,192	16,384	32,768	65,536	
Binary values →	128	64	32	16	8	4	2	1	.	128	64	32	16	8	4	2	1	
172 . 59 .	0	0	0	0	0	0	0	0	.	0	0	0	0	0	0	0	0	

128
64
32
16
8
4
2
+1
255

128
+64
192

64
-2
62

1,024
-2
1,022

Custom Subnet Masks

Problem 16

Number of needed usable hosts **29**

Network Address **23.0.0.0**

Address class A

Default subnet mask 255 . 0 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 224

Total number of subnets 524,288

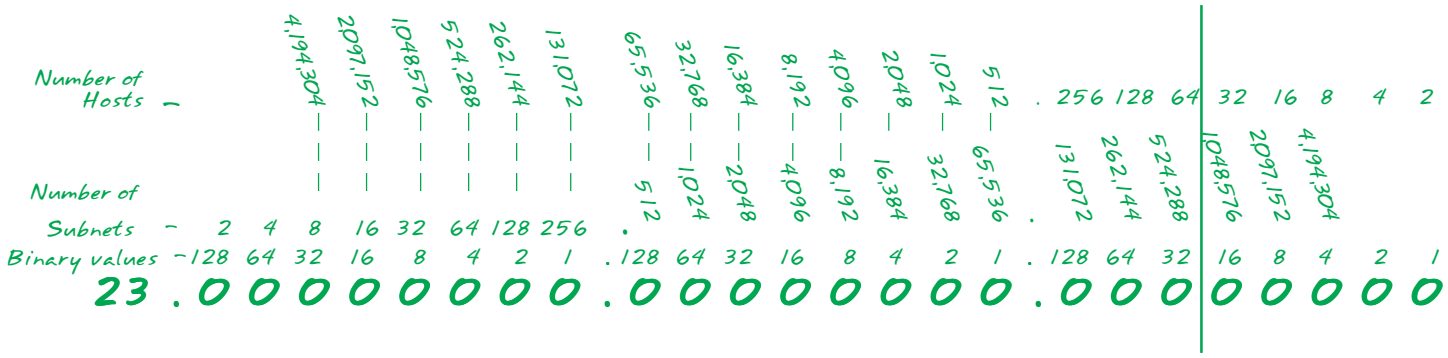
Number of usable subnets 524,286

Total number of host addresses 32

Number of usable addresses 30

Number of bits borrowed 19

Show your work for Problem 16 in the space below.



128
64
+32
224

32
-2
30

524,288
-2
524,286

Subnetting

Problem 1

Number of needed usable subnets **14**
Number of needed usable hosts **14**
Network Address **192.10.10.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 240

Total number of subnets 16

Number of usable subnets 14

Total number of host addresses 16

Number of usable addresses 14

Number of bits borrowed 4

What is the 3rd usable subnet range? 192.10.10.48 to 192.10.10.63

What is the subnet number for the 7th usable subnet? 192 . 10 . 10 . 112

What is the subnet broadcast address for the 12th usable subnet? 192 . 10 . 10 . 207

What are the assignable addresses for the 8th usable subnet? 192.10.10.129 to 192.10.10.142

Show your work for Problem 1 in the space below.

Number of Subnets	256	128	64	32	16	8	4	2	Number of Hosts
-	2	4	8	16	32	64	128	256	
	128	64	32	16	8	4	2	1	Binary values
192.10.10.0	0	0	0	0	0	0	0	0	

(Invalid range)	(0)	0	0	0	0	192.10.10.0	to 192.10.10.15
	(1)	0	0	0	1	192.10.10.16	to 192.10.10.31
	(2)	0	0	1	0	192.10.10.32	to 192.10.10.47
	(3)	0	0	1	1	192.10.10.48	to 192.10.10.63
	(4)	0	1	0	0	192.10.10.64	to 192.10.10.79
	(5)	0	1	0	1	192.10.10.80	to 192.10.10.95
	(6)	0	1	1	0	192.10.10.96	to 192.10.10.111
	(7)	0	1	1	1	192.10.10.112	to 192.10.10.127
	(8)	1	0	0	0	192.10.10.128	to 192.10.10.143
	(9)	1	0	0	1	192.10.10.144	to 192.10.10.159
	(10)	1	0	1	0	192.10.10.160	to 192.10.10.175
	(11)	1	0	1	1	192.10.10.176	to 192.10.10.191
	(12)	1	1	0	0	192.10.10.192	to 192.10.10.207
	(13)	1	1	0	1	192.10.10.208	to 192.10.10.223
	(14)	1	1	1	0	192.10.10.224	to 192.10.10.239
(Invalid range)	(15)	1	1	1	1	192.10.10.240	to 192.10.10.255

Custom subnet mask:
128
64
32
+16
240

Usable subnets:
16
-2
14

Usable hosts:
16
-2
14

The binary value of the last bit borrowed is the range. In this problem the range is 16.

The first and last range of addresses are not usable.

The first usable range of addresses is: 192.10.10.16 to 192.10.10.31.

The first address in each subnet range is the subnet number.

The last address in each subnet range is the subnet broadcast address.

Subnetting

Problem 2

Number of needed usable subnets **1000**
Number of needed usable hosts **60**
Network Address **165.100.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 1,024

Number of usable subnets 1,022

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 10

What is the 14th usable subnet range? 165.100.3.128 to 165.100.3.191

What is the subnet number for the 5th usable subnet? 165 . 100 . 1 . 64

What is the subnet broadcast address for the 5th usable subnet? 165 . 100 . 1 . 127

What are the assignable addresses for the 8th usable subnet? 165.100.2.1 to 165.100.0.62

Show your work for Problem 2 in the space below.

Number of Hosts →	65,536	32,768	16,384	8,192	4,096	2,048	1,024	512	256	128	64	32	16	8	4	2
Number of Subnets →	2	4	8	16	32	64	128	256	512	1024	2048	4,096	8,192	16,384	32,768	65,536
Binary values →	128	64	32	16	8	4	2	1	. 128	64	32	16	8	4	2	1
165 . 100 .	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**. 0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

(Invalid range)	(0)	.	0	165.100.0.0	to 165.100.0.63
	(1)		1	165.100.0.64	to 165.100.0.127
	(2)		0	165.100.0.128	to 165.100.0.191
	(3)		1	165.100.0.192	to 165.100.0.255
	(4)	1 .	0	165.100.1.0	to 165.100.1.63
	(5)	1 .	1	165.100.1.64	to 165.100.1.127
	(6)	1 .	0	165.100.1.128	to 165.100.1.191
	(7)	1 .	1	165.100.1.192	to 165.100.1.255
	(8)	1 0 .	0	165.100.2.0	to 165.100.0.63
	(9)	1 0 .	1	165.100.2.64	to 165.100.0.127
	(10)	1 0 .	0	165.100.2.128	to 165.100.0.191
	(11)	1 0 .	1	165.100.2.192	to 165.100.0.255
	(12)	1 1 .	0	165.100.3.0	to 165.100.3.63
	(13)	1 1 .	1	165.100.3.64	to 165.100.3.127
	(14)	1 1 .	0	165.100.3.128	to 165.100.3.191
	(15)	1 1 .	1	165.100.3.192	to 165.100.3.255
				Down to	
	(1022)	1 1 1 1 1 1 1 1 .	0	165.100.255.128	to 165.100.255.191
(Invalid range)	(1023)	1 1 1 1 1 1 1 1 .	1	165.100.255.192	to 165.100.255.255

64 − 2 = 62 Usable hosts

1024 − 2 = 1,022 Usable subnets

128 + 64 = 192 Custom subnet mask

128 64 32 16 8 4 2 +1 = 255

The binary value of the last bit borrowed is the range. In this problem the range is 64.

The first and last range of addresses are not usable.

The first usable range of addresses is: 165.100.0.64 to 165.100.0.127

The first address in each subnet range is the subnet number.

The last address in each subnet range is the subnet broadcast address.

Subnetting

Problem 3

Number of needed usable subnets **1**

Network Address **195.223.50.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 4

Number of usable subnets 2

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 2

What is the 2nd usable subnet range? 195.223.50.128 - 195.223.50.191

What is the subnet number for the 1st usable subnet? 195.223.50.64

What is the subnet broadcast address for the 1st usable subnet? 195.223.50.127

What are the assignable addresses for the 2nd usable subnet? 195.223.50.129 - 195.223.50.190

Show your work for <u>Problem 3</u> in the space below.

Number of Subnets		256	128	64	32	16	8	4	2	- Number of Hosts
	-	2	4	8	16	32	64	128	256	
		128	64	32	16	8	4	2	1	- Binary values
195.223.50.0		0	0	0	0	0	0	0	0	

(Invalid range)	(0)	0	0	195.223.50.0	to	195.223.50.63
	(1)	0	1	195.223.50.64	to	195.223.50.127
	(2)	1	0	195.223.50.128	to	195.223.50.191
(Invalid range)	(3)	1	1	195.223.50.192	to	195.223.50.255

128	4	64
+64	-2	-2
192	2	62

Subnetting

Problem 4

Number of needed usable subnets **750**

Network Address **190.35.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 1,024

Number of usable subnets 1,022

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 10

What is the 14th usable subnet range? 190.35.3.128 to 190.35.3.191

What is the subnet number for the 12th usable subnet? 190.35.3.0

What is the subnet broadcast address for the 9th usable subnet? 190.35.2.127

What are the assignable addresses for the 5th usable subnet? 190.35.1.65 to 190.35.1.126

Show your work for <u>Problem 4</u> in the space below.

Number of Hosts - 65,536 32,768 16,384 8,192 4,096 2048 1024 512

Number of Subnets - 2 4 8 16 32 64 128 256

Binary values - 128 64 32 16 8 4 2 1

190.35.0.0 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0 0

(Invalid range)	(0)	190.35.0.0	to 190.35.0.63
	(1)	190.35.0.64	to 190.35.0.127
	(2)	190.35.0.128	to 190.35.0.191
	(3)	190.35.0.192	to 190.35.0.255
	(4)	190.35.1.0	to 190.35.1.63
	(5)	190.35.1.64	to 190.35.1.127
	(6)	190.35.1.128	to 190.35.1.191
	(7)	190.35.1.192	to 190.35.1.255
	(8)	190.35.2.0	to 190.35.2.63
	(9)	190.35.2.64	to 190.35.2.127
	(10)	190.35.2.128	to 190.35.2.191
	(11)	190.35.2.192	to 190.35.2.255
	(12)	190.35.3.0	to 190.35.3.63
	(13)	190.35.3.64	to 190.35.3.127
	(14)	190.35.3.128	to 190.35.3.191
	(15)	190.35.3.192	to 190.35.3.255

128 + 64 + 32 + 16 + 8 + 4 + 2 + 1 = 255

1,024 - 2 = 1,022

128 + 64 + 32 + 16 + 8 + 4 + 1 = 252

64 - 2 = 62

128 + 64 = 252

Subnetting

Problem 5

Number of needed usable hosts **6**

Network Address **126.0.0.0**

Address class A

Default subnet mask 255 . 0 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 248

Total number of subnets 2,097,152

Number of usable subnets 2,097,150

Total number of host addresses 8

Number of usable addresses 6

Number of bits borrowed 21

What is the 1st usable subnet range? 126.0.0.8 to 126.0.0.15

What is the subnet number for the 4th usable subnet? 126.0.0.32

What is the subnet broadcast address for the 6th usable subnet? 126.0.0.55

What are the assignable addresses for the 9th usable subnet? 126.0.0.73 to 126.0.0.78

Show your work for <u>Problem 5</u> in the space below.

Subnetting

Problem 6

Number of needed usable subnets **10**

Network Address **192.70.10.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 240

Total number of subnets 16

Number of usable subnets 14

Total number of host addresses 16

Number of usable addresses 14

Number of bits borrowed 4

What is the 8th usable subnet range? 192.70.10.128 to 192.70.10.143

What is the subnet number for the 3rd usable subnet? 192.70.10.48

What is the subnet broadcast address for the 11th usable subnet? 192.70.10.191

What are the assignable addresses for the 9th usable subnet? 192.70.10.145 to 192.70.10.158

Show your work for <u>Problem 6</u> in the space below.

		Number of Subnets				256	128	64	32	16	8	4	2	Number of Hosts
		-	2	4	8	16	32	64	128	256				
						128	64	32	16	8	4	2	1	Binary values
192 . 70 . 10 .						0	0	0	0	0	0	0	0	
(Invalid range)	(0)								0	192.70.10.0	to	192.70.10.15		
	(1)								1	192.70.10.16	to	192.70.10.31		
	(2)							1	0	192.70.10.32	to	192.70.10.47		
	(3)							1	1	192.70.10.48	to	192.70.10.63		
	(4)						1	0	0	192.70.10.64	to	192.70.10.79		
	(5)						1	0	1	192.70.10.80	to	192.70.10.95		
	(6)						1	1	0	192.70.10.96	to	192.70.10.111		
	(7)						1	1	1	192.70.10.112	to	192.70.10.127		
	(8)					1	0	0	0	192.70.10.128	to	192.70.10.143		
	(9)					1	0	0	1	192.70.10.144	to	192.70.10.159		
	(10)					1	0	1	0	192.70.10.160	to	192.70.10.175		
	(11)					1	0	1	1	192.70.10.176	to	192.70.10.191		
	(12)					1	1	0	0	192.70.10.192	to	192.70.10.0207		
	(13)					1	1	0	1	192.70.10.208	to	192.70.10.223		
	(14)					1	1	1	0	192.70.10.224	to	192.70.10.239		
(Invalid range)	(15)					1	1	1	1	192.70.10.240	to	192.70.10.255		

128	16	16
+64	-2	-2
240	14	14

Subnetting

Problem 7

Network Address **10.0.0.0 /16**

Address class A

Default subnet mask 255 . 0 . 0 . 0

Custom subnet mask 255 . 255 . 0 . 0

Total number of subnets 256

Number of usable subnets 254

Total number of host addresses 65,536

Number of usable addresses 65,534

Number of bits borrowed 8

What is the 10th usable subnet range? 10.10.0.0 to 10.10.255.255

What is the subnet number for the 5th usable subnet? 10.5.0.0

What is the subnet broadcast address for the 1st usable subnet? 10.1.255.255

What are the assignable addresses for the 8th usable subnet? 10.8.0.1 to 10.8.255.254

Show your work for <u>Problem 7</u> in the space below.

Subnetting

Problem 8

Number of needed usable subnets **4**

Network Address **172.50.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 224 . 0

Total number of subnets 8

Number of usable subnets 6

Total number of host addresses 8,192

Number of usable addresses 8,190

Number of bits borrowed 3

What is the 3rd usable subnet range? 172.50.96.0 to 172.50.127.255

What is the subnet number for the 4th usable subnet? 172.50.128.0

What is the subnet broadcast address for the 5th usable subnet? 172.50.191.255

What are the assignable addresses for the 2nd usable subnet? 172.50.64.1 to 172.50.95.254

Show your work for <u>Problem 8</u> in the space below.

Number of Hosts - 65,536 32,768 16,384 8,192 4,096 2,048 1,024 512

Number of Subnets - 2 4 8 16 32 64 128 256

Binary values - 128 64 32 16 8 4 2 1

172.50.0.0 | 0 0 0 0 0 0 0 0

(Invalid range) (0)	0	172.50.0.0	to 172.50.31.255
(1)	1	172.50.32.0	to 172.50.63.255
(2)	1 0	172.50.64.0	to 172.50.95.255
(3)	1 1	172.50.96.0	to 172.50.127.255
(4)	1 0 0	172.50.128.0	to 172.50.159.255
(5)	1 0 1	172.50.160.0	to 172.50.191.255
(6)	1 1 0	172.50.192.0	to 172.50.223.255
(Invalid range) (7)	1 1 1	172.50.224.0	to 172.50.255.255

128
64
+32
224

8,192
-2
8,190

8
-2
6

Subnetting

Problem 9

Number of needed usable hosts **28**

Network Address **172.50.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 224

Total number of subnets 2,048

Number of usable subnets 2,046

Total number of host addresses 32

Number of usable addresses 30

Number of bits borrowed 11

What is the 1st usable subnet range? 172.50.0.32 to 172.50.0.63

What is the subnet number for the 9th usable subnet? 172.50.1.32

What is the subnet broadcast address for the 3rd usable subnet? 172.50.0.127

What are the assignable addresses for the 5th usable subnet? 172.50.0.161 to 172.50.0.190

Show your work for <u>Problem 9</u> in the space below.

Number of Hosts –	65,536	32,768	16,384	8,192	4,096	2,048	1,024	512	.256	128	64	32	16	8	4	2
Number of Subnets –	2	4	8	16	32	64	128	256.	512	1024	2048	4,096	8,192	16,384	32,768	65,536
Binary values –	128	64	32	16	8	4	2	1 .	128	64	32	16	8	4	2	1
172 . 50 .	0	0	0	0	0	0	0	0 .	0	0	0	0	0	0	0	0

Subnet	Bits	Range start		Range end
(Invalid range) (0)	. 0	172.50.0.0	to	172.50.0.31
(1)	1	172.50.0.32	to	172.50.0.63
(2)	1 0	172.50.0.64	to	172.50.0.95
(3)	1 1	172.50.0.96	to	172.50.0.127
(4)	1 0 0	172.50.0.128	to	172.50.0.159
(5)	1 0 1	172.50.0.160	to	172.50.0.191
(6)	1 1 0	172.50.0.192	to	172.50.0.223
(7)	1 1 1	172.50.0.224	to	172.50.0.255
(8)	1 . 0 0 0	172.50.1.0	to	172.50.1.31
(9)	1 . 0 0 1	172.50.1.32	to	172.50.1.63
(10)	1 . 0 1 0	172.50.1.64	to	172.50.1.95
(11)	1 . 0 1 1	172.50.1.96	to	172.50.1.127
(12)	1 . 1 0 0	172.50.1.128	to	172.50.1.159
(13)	1 . 1 0 1	172.50.1.160	to	172.50.1.191
(14)	1 . 1 1 0	172.50.1.192	to	172.50.1.223
(15)	1 . 1 1 1	172.50.1.224	to	172.50.1.255

$$128 + 64 + 32 + 16 + 8 + 4 + 2 + 1 = 252$$

$$128 + 64 + 32 = 224$$

$$1{,}024 - 2 = 1{,}022$$

$$64 - 2 = 62$$

Subnetting

Problem 10

Number of needed usable subnets **45**

Network Address **220.100.100.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 252

Total number of subnets 64

Number of usable subnets 62

Total number of host addresses 4

Number of usable addresses 2

Number of bits borrowed 6

What is the 4th usable subnet range? 220.100.100.16 to 220.100.100.19

What is the subnet number for the 3rd usable subnet? 220.100.100.12

What is the subnet broadcast address for the 12th usable subnet? 220.100.100.51

What are the assignable addresses for the 11th usable subnet? 220.100.100.45 to 220.100.100.46

Show your work for Problem 10 in the space below.

		256	128	64	32	16	8	4	2	– Number of Hosts
Number of Subnets	–	2	4	8	16	32	64	128	256	
		128	64	32	16	8	4	2	1	– Binary values
220 . 100 . 100 .		0	0	0	0	0	0	0	0	

						Range		
(Invalid range)	(0)				0	220.100.100.0	to	220.100.100.3
	(1)				1	220.100.100.4	to	220.100.100.7
	(2)			1	0	220.100.100.8	to	220.100.100.11
	(3)			1	1	220.100.100.12	to	220.100.100.15
	(4)		1	0	0	220.100.100.16	to	220.100.100.19
	(5)		1	0	1	220.100.100.20	to	220.100.100.23
	(6)		1	1	0	220.100.100.24	to	220.100.100.27
	(7)		1	1	1	220.100.100.28	to	220.100.100.31
	(8)	1	0	0	0	220.100.100.32	to	220.100.100.35
	(9)	1	0	0	1	220.100.100.36	to	220.100.100.39
	(10)	1	0	1	0	220.100.100.40	to	220.100.100.43
	(11)	1	0	1	1	220.100.100.44	to	220.100.100.47
	(12)	1	1	0	0	220.100.100.48	to	220.100.100.51
	(13)	1	1	0	1	220.100.100.52	to	220.100.100.55
	(14)	1	1	1	0	220.100.100.56	to	220.100.100.59
	(15)	1	1	1	1	220.100.100.60	to	220.100.100.63

128
64
32
16
8
+4
252

64
−2
62

4
−2
2

Subnetting

Problem 11

Number of needed usable hosts **8,000**

Network Address **135.70.0.0**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 224 . 0

Total number of subnets 8

Number of usable subnets 6

Total number of host addresses 8,192

Number of usable addresses 8,190

Number of bits borrowed 3

What is the 5th usable subnet range? 135.70.160.0 to 135.70.191.255

What is the subnet number for the 6th usable subnet? 135.70.192.0

What is the subnet broadcast address for the 2nd usable subnet? 135.70.95.255

What are the assignable addresses for the 4th usable subnet? 135.70.128.1 to 135.70.159.254

Show your work for <u>Problem 11</u> in the space below.

Subnetting

Problem 12

Number of needed usable hosts **45**

Network Address **198.125.50.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 4

Number of usable subnets 2

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 2

What is the 1st usable subnet range? 198.125.50.64 to 98.125.50.127

What is the subnet number for the 1st usable subnet? 198.125.50.64

What is the subnet broadcast address for the 2nd usable subnet? 198.125.50.191

What are the assignable addresses for the 2nd usable subnet? 198.125.50.129 to 198.125.50.190

Show your work for <u>Problem 12</u> in the space below.

Number of Subnets		256	128	64	32	16	8	4	2	Number of Hosts
		2	4	8	16	32	64	128	256	
		128	64	32	16	8	4	2	1	Binary values
198 . 125 . 50 .		0	0	0	0	0	0	0	0	
(Invalid range)	(0)		0	198.125.50.0	to	198.125.50.63				
	(1)		1	198.125.50.64	to	198.125.50.127				
	(2)	1	0	198.125.50.128	to	198.125.50.191				
(Invalid range)	(3)	1	1	198.125.50.192	to	198.125.50.255				

128	4	64
+64	-2	-2
192	2	62

Subnetting

Problem 13

Network Address **165.200.0.0 /26**

Address class B

Default subnet mask 255 . 255 . 0 . 0

Custom subnet mask 255 . 255 . 255 . 192

Total number of subnets 1,024

Number of usable subnets 1,022

Total number of host addresses 64

Number of usable addresses 62

Number of bits borrowed 10

What is the 9th usable subnet range? 165.200.2.64 to 165.200.2.127

What is the subnet number for the 10th usable subnet? 165.200.2.128

What is the subnet broadcast address for the 1022nd usable subnet? 165.200.255.191

What are the assignable addresses for the 1021st usable subnet? 165.200.255.65 to 165.200.255.126

Show your work for <u>Problem 13</u> in the space below.

Number of Hosts - 65,536 32,768 16,384 8,192 4,096 2048 1024 512

Number of Subnets - 2 4 8 16 32 64 128 256.

Binary values - 128 64 32 16 8 4 2 1 . 128 64 32 16 8 4 2 1

165 . 200 . 0 . 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0

		(Invalid range)	(0)	165.200.0.0 to 165.200.0.63
			(1)	165.200.0.64 to 165.200.0.127
128			(2)	165.200.0.128 to 165.200.0.191
64			(3)	165.200.0.192 to 165.200.0.255
32			(4)	165.200.1.0 to 165.200.1.63
16			(5)	165.200.1.64 to 165.200.1.127
8			(6)	165.200.1.128 to 165.200.1.191
4			(7)	165.200.1.192 to 165.200.1.255
2			(8)	165.200.2.0 to 165.200.2.63
+1			(9)	165.200.2.64 to 165.200.2.127
252			(10)	165.200.2.128 to 165.200.2.191
			(11)	165.200.2.192 to 165.200.2.255
	128		(12)	165.200.3.0 to 165.200.3.63
	+64		(13)	165.200.3.64 to 165.200.3.127
	252		(14)	165.200.3.128 to 165.200.3.191
			(15)	165.200.3.192 to 165.200.3.255
64			(1021)	165.200.255.64 to 165.200.255.127
-2			(1022)	165.200.155.128 to 165.200.255.191
62		(Invalid range)	(1023)	165.200.255.192 to 165.200.255.255

Subnetting

Problem 14

Number of needed usable hosts **16**

Network Address **200.10.10.0**

Address class C

Default subnet mask 255 . 255 . 255 . 0

Custom subnet mask 255 . 255 . 255 . 224

Total number of subnets 8

Number of usable subnets 6

Total number of host addresses 32

Number of usable addresses 30

Number of bits borrowed 3

What is the 6th usable subnet range? 200.10.10.192 to 200.10.10.223

What is the subnet number for the 4th usable subnet? 200.10.10.128

What is the subnet broadcast address for the 3rd usable subnet? 200.10.10.127

What are the assignable addresses for the 5th usable subnet? 200.10.10.161 to 200.10.10.190

Show your work for <u>Problem 14</u> in the space below.

Number of Subnets		256	128	64	32	16	8	4	2	Number of Hosts
		2	4	8	16	32	64	128	256	
		128	64	32	16	8	4	2	1	Binary values
200 . 10 . 10 .		0	0	0	0	0	0	0	0	
(Invalid range)	(0)			0	200.10.10.0	to	200.10.10.31			
	(1)			1	200.10.10.32	to	200.10.10.63			
	(2)		1	0	200.10.10.64	to	200.10.10.95			
	(3)		1	1	200.10.10.96	to	200.10.10.127			
	(4)	1	0	0	200.10.10.128	to	200.10.10.159			
	(5)	1	0	1	200.10.10.160	to	200.10.10.191			
	(6)	1	1	0	200.10.10.192	to	200.10.10.223			
(Invalid range)	(7)	1	1	1	200.10.10.224	to	200.10.10.255			

128		
64	8	32
+32	-2	-2
224	6	30

Subnetting

Problem 15

Network Address **93.0.0.0 \19**

Address class A

Default subnet mask 255 . 0 . 0 . 0

Custom subnet mask 255 . 255 . 224 . 0

Total number of subnets 2,048

Number of usable subnets 2,046

Total number of host addresses 8,192

Number of usable addresses 8,190

Number of bits borrowed 11

What is the 14th usable subnet range? 93.1.192.0 to 93.1.223.255

What is the subnet number for the 8th usable subnet? 93.1.0.0

What is the subnet broadcast address for the 6th usable subnet? 93.0.223.255

What are the assignable addresses for the 11th usable subnet? 93.1.96.1 to 93.1.127.254

Show your work for <u>Problem 15</u> in the space below.

128
64
32
16
8
4
2
+1
255

128
64
+32
224

2,048
-2
2,046

8,192
-2
8,190

Valid and Non-Valid IP Addresses

Using the material in this workbook identify which of the addresses below are correct and usable. If they are not usable addresses explain why.

IP Address: 0.230.190.192
Subnet Mask: 255.0.0.0
Reference Page Inside Front Cover

The network ID cannot be 0.

IP Address: 192.10.10.1
Subnet Mask: 255.255.255.0
Reference Pages 26-27

OK

IP Address: 245.150.190.10
Subnet Mask: 255.255.255.0
Reference Page Inside Front Cover

245 is reserved for experimental use.

IP Address: 135.70.191.255
Subnet Mask: 255.255.254.0
Reference Pages 46-47

This is the broadcast address for this range.

IP Address: 127.100.100.10
Subnet Mask: 255.0.0.0
Reference Pages Inside Front Cover

127 is reserved for loopback testing.

IP Address: 93.0.128.1
Subnet Mask: 255.255.224.0
Reference Pages 54-55

OK

IP Address: 200.10.10.128
Subnet Mask: 255.255.255.224
Reference Pages 52-53

This is the subnet address for the 3rd usable range of 200.10.10.0

IP Address: 165.100.255.189
Subnet Mask: 255.255.255.192
Reference Pages 28-29

OK

IP Address: 190.35.0.10
Subnet Mask: 255.255.255.192
Reference Pages 32-33

This address is taken from the first range for this subnet which is invalid.

IP Address: 218.35.50.195
Subnet Mask: 255.255.0.0
Reference Page Inside Front Cover

This has a class B subnet mask.

IP Address: 200.10.10.175 /22
Reference Pages 52-53 and/or Inside Front Cover

A class C address must use a minimum of 24 bits.

IP Address: 135.70.255.255
Subnet Mask: 255.255.224.0
Reference Pages 46-47

This is a broadcast address.

IP Address Breakdown

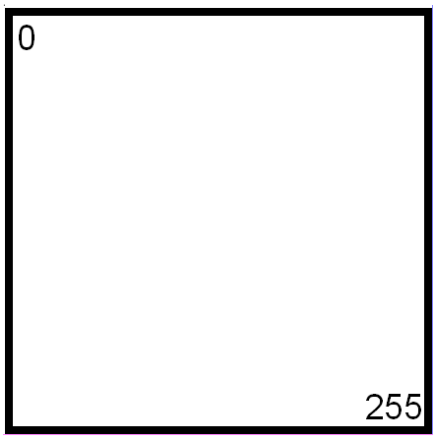
/24 255.255.255.0 256 Hosts	/25 255.255.255.128 128 Hosts	/26 255.255.255.192 64 Hosts	/27 255.255.255.224 32 Hosts	/28 255.255.255.240 16 Hosts	/29 255.255.255.248 8 Hosts	/30 255.255.255.252 4 Hosts
0-255	0-127	0-63		0-15	0-7	0-3
						4-7
					8-15	8-11
						12-15
				16-31	16-23	16-19
						20-23
					24-31	24-27
						28-31
				32-47	32-39	32-35
						36-39
					40-47	40-43
						44-47
				48-63	48-55	48-51
						52-55
					56-63	56-59
						60-63
		64-127		64-79	64-71	64-67
						68-71
					72-79	72-75
						76-79
				80-95	80-87	80-83
						84-87
					88-95	88-91
						92-95
				96-111	96-103	96-99
						100-103
					104-111	104-107
						108-111
				112-127	112-119	112-115
						116-119
					120-127	120-123
						124-127
	128-255	128-191		128-143	128-135	128-131
						132-135
					136-143	136-139
						140-143
				144-159	144-151	144-147
						148-151
					152-159	152-155
						156-159
				160-175	16-167	160-163
						164-167
					168-175	168-171
						172-175
				176-191	176-183	176-179
						180-183
					184-191	184-187
						188-191
		192-255		192-207	192-199	192-195
						196-199
					200-207	200-203
						204-207
				208-223	208-215	208-211
						212-215
					216-223	216-219
						220-223
				224-239	224-231	224-227
						228-231
					232-239	232-235
						236-239
				240-255	240-247	240-243
						244-247
					248-255	248-251
						252-255

Visualizing Subnets Using The Box Method

The box method is the simplest way to visualize the breakdown of subnets and addresses into smaller sizes.

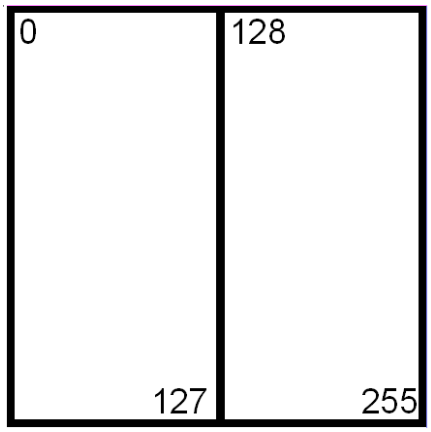
Start with a square. The whole square is a single subnet comprised of 256 addresses.

/24
255.255.255.0
256 Hosts
1 Subnet



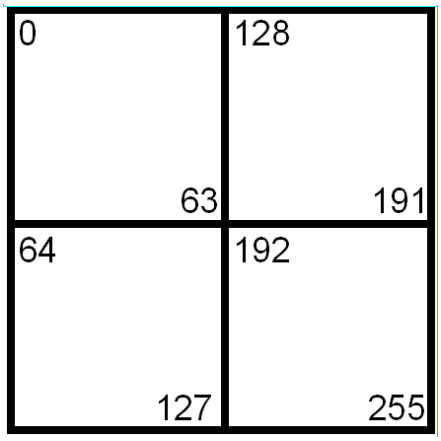
Split the box in half and you get two subnets with 128 addresses,

/25
255.255.255.128
128 Hosts
2 Subnets



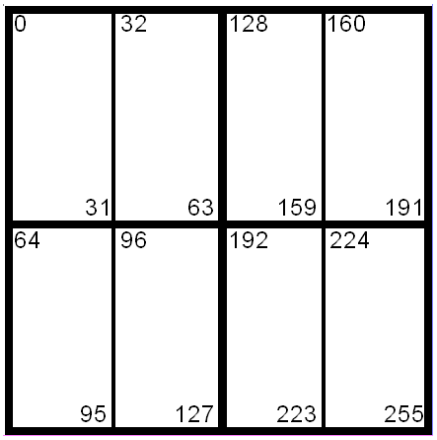
Divide the box into quarters and you get four subnets with 64 addresses,

/26
255.255.255.192
64 Hosts
4 Subnets



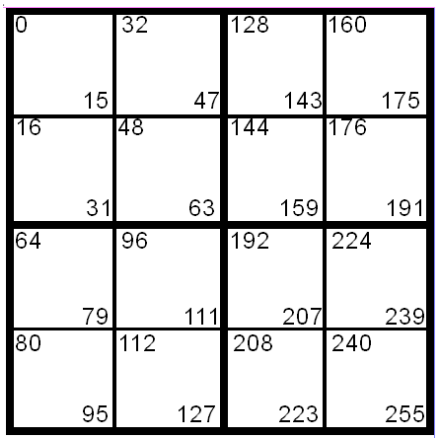
Split each individual square and you get eight subnets with 32 addresses,

/27
255.255.255.224
32 Hosts
8 Subnets



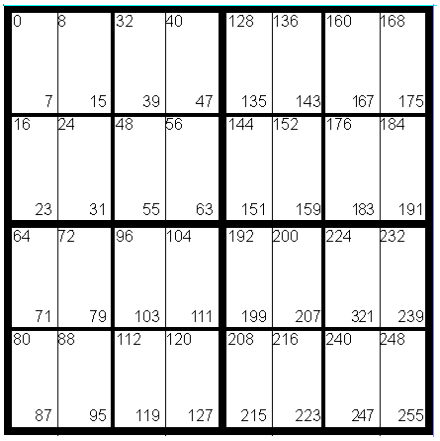
Split the boxes in half again and you get sixteen subnets with sixteen addresses,

/28
255.255.255.240
16 Hosts
16 Subnets



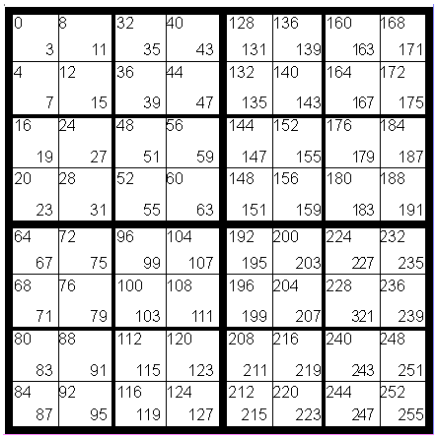
The next split gives you thirty two subnets with eight addresses,

/29
255.255.255.248
8 Hosts
32 Subnets



The last split gives sixty four subnets with four addresses each,

/30
255.255.255.252
4 Hosts
64 Subnets



Class A Addressing Guide

# of Bits Borrowed	Subnet Mask	Total # of Subnets	Usable # of Subnets	Total # of Hosts	Usable # of Hosts
2	255.192.0.0	4	2	4,194,304	4,194,302
3	255.224.0.0	8	6	2,097,152	2,097,150
4	255.240.0.0	16	14	1,048,576	1,048,574
5	255.248.0.0	32	30	524,288	524,286
6	255.252.0.0	64	62	262,144	262,142
7	255.254.0.0	128	126	131,072	131,070
8	255.255.0.0	256	254	65,536	65,534
9	255.255.128.0	512	510	32,768	32,766
10	255.255.192.0	1,024	1,022	16,384	16,382
11	255.255.224.0	2,048	2,046	8,192	8,190
12	255.255.240.0	4,096	4,094	4,096	4,094
13	255.255.248.0	8,192	8,190	2,048	2,046
14	255.255.252.0	16,384	16,382	1,024	1,022
15	255.255.254.0	32,768	32,766	512	510
16	255.255.255.0	65,536	65,534	256	254
17	255.255.255.128	131,072	131,070	128	126
18	255.255.255.192	262,144	262,142	64	62
19	255.255.255.224	524,288	524,286	32	30
20	255.255.255.240	1,048,576	1,048,574	16	14
21	255.255.255.248	2,097,152	2,097,150	8	6
22	255.255.255.252	4,194,304	4,194,302	4	2

Class B Addressing Guide

# of Bits Borrowed	Subnet Mask	Total # of Subnets	Usable # of Subnets	Total # of Hosts	Usable # of Hosts
2	255.255.192.0	4	2	16,384	16,382
3	255.255.224.0	8	6	8,192	8,190
4	255.255.240.0	16	14	4,096	4,094
5	255.255.248.0	32	30	2,048	2,046
6	255.255.252.0	64	62	1,024	1,022
7	255.255.254.0	128	126	512	510
8	255.255.255.0	256	254	256	254
9	255.255.255.128	512	510	128	126
10	255.255.255.192	1,024	1,022	64	62
11	255.255.255.224	2,048	2,046	32	30
12	255.255.255.240	4,096	4,094	16	14
13	255.255.255.248	8,192	8,190	8	6
14	255.255.255.252	16,384	16,382	4	2

Class C Addressing Guide

# of Bits Borrowed	Subnet Mask	Total # of Subnets	Usable # of Subnets	Total # of Hosts	Usable # of Hosts
2	255.255.255.192	4	2	64	62
3	255.255.255.224	8	6	32	30
4	255.255.255.240	16	14	16	14
5	255.255.255.248	32	30	8	6
6	255.255.255.252	64	62	4	2